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Flectobacillus marinus (Raj) comb. nov., a Marine Bacterium Previously Assigned to *Microcyclus*

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Microcyclus marinus Raj appears to be more closely related to the genus *Flectobacillus* Larkin et al. than to the genus *Microcyclus* Ørskov. By reason of the transfer to the genus *Flectobacillus,* the name of the species becomes *Flectobacillus marinus* (Raj) comb. nov. Minor modifications in the description of the genus *Flectobacillus* are required by this change.

Until recently the genus *Microcyclus* Ørskov 1928 had been a poorly defined group consisting of three species of gram-negative, respiratory, strictly aerobic, nonmotile, curved cells. The cells may curve enough so that the ends of the cells overlap to produce a ring, or doughnut, appearance. That this genus consisted of several dissimilar organisms and was in need of realignment was pointed out several times (1-3, 5). Larkin et al. (3) undertook this task and made the following changes. Firstly, the genus *Spirosoma* Migula 1894 was reintroduced, as was suggested by Claus et al. (1), and *Microcyclus flavus* Raj 1970 became *Spirosoma linguale.* The description of the genus *Spirosoma* was emended. Secondly, the new genus *Flectobacillus* was created to contain *M. major* Gromov 1963. Thirdly, the genus *Microcyclus* was redefined and contained only one species, *M. aquaticus.* Each genus thus consisted of one of the three species that appeared in *Bergey's Manual,* 8th ed. (5).

While this reclassification of the genus was in press, Raj (4) reported the characteristics of a new species of *Microcyclus* for which he proposed the name *M. marinus.* The description of this organism as prepared by Raj (4) closely fits the description of the new genus *Flectobacillus,* and we have carried out an investigation to see if *M. marinus* should be reclassified as a species of *Flectobacillus.*

The type strain of *M. marinus,* American Type Culture Collection (ATCC) number 25205, was obtained from H. D. Raj. The type strain of *Flectobacillus major,* which is the type species of the genus *Flectobacillus,* was obtained through the courtesy of D. Claus of Göttingen, Germany, from the Deutsche Sammlung von Mikroorganismen (DSM) with the accession number 109. The two organisms were first compared on the basis of their published descriptions and then on the basis of their characteristics as determined in the laboratory. The techniques used for the growth and determination of the characteristics of the organisms were published previously (3, 4). Our laboratory results (Table 1) agreed with the published descriptions of both strains.

Cells of the two organisms are very similar in morphology, ranging from nearly straight rods to coiled filaments. They are nonmotile, and on *Microcyclus-Spirosoma* agar (3) supplemented with 3.0% NaCl for *M. marinus* they produce a non-water-soluble pink pigment. They are both respiratory in metabolism and produce acid aerobically from the same carbohydrates and alcohols. The guanine-plus-cytosine contents of the deoxyribonucleic acids are 38.3 and 39.5 mol% for *M. marinus* and *F. major,* respectively. The guanine-plus-cytosine content of the deoxyribonucleic acid of *M. aquaticus,* the type species of *Microcyclus,* ranges from 66.3 to 68.4 mol%.

In many additional characters, *M. marinus* and *F. major* are similar, and it seems clear that *M. marinus* should be transferred to the genus *Flectobacillus.* Differences between the two species do exist in that *F. major* is a larger, more loosely coiled organism and is more versatile than *M. marinus* in its hydrolytic reactions and less versatile in its ability to utilize single carbon sources (3, 4). In addition, *M. marinus* requires at least 1.5% NaCl in the medium for good growth to occur. Because of these differences with *F. major,* we feel that *M. marinus* is distinct from *F. major* and that it should be recognized as a separate species. We propose, therefore, that *M. marinus* Raj be transferred to *Flectobacillus* as *Flectobacillus marinus* (Raj) comb. nov.

Because *M. marinus* is smaller than *F. major* and has a slightly lower guanine-plus-cytosine content in its deoxyribonucleic acid, the description of *Flectobacillus* should be emended accordingly. All other characteristics in the generic description remain unchanged. An emended description of this genus follows.

Genus *Flectobacillus* Larkin et al. 1977

TABLE 1. *Comparison of the characteristics of the type strains of M. marinus and F. major*

Characteristic	*M. marinus* ATCC 25205	*F. major* DSM 109
Gram reaction	−	−
Pink pigment produced	+	+
Fluorescence	−	−
Motility	−	−
Mol% guanine plus cytosine	38.3	39.5
Formation of coils	+	+
Formation of filaments	+	+
Cell size:		
Length (μm)	2.0–5.0	2.0–5.0
Diam (μm)	0.3–0.7	0.6–1.0
Diam of rings (μm)	0.8–2.0	5.0–10.0
Filament length (μm)	>50	>50
Acid produced aerobically from:		
Pentoses		
Arabinose	+	+
Xylose	+	+
Methyl pentose: rhamnose	+	+
Hexoses		
Fructose	+	+
Galactose	+	+
Glucose	+	+
Mannose	+	+
Glucoside: salicin	+	+
Disaccharides		
Lactose	+	+
Maltose	+	+
Sucrose	+	+
Trehalose	+	+
Trisaccharide: raffinose	+	+
Polysaccharide: inulin	+	+
Alcohols		
Glycerol	−	−
Dulcitol	−	−
Mannitol	−	−
Sorbitol	−	−
Utilization of single carbon sources:		
Acetate	+	−
Benzoate	−	−
Citrate	+	−
Formate	−	−
Malonate	+	−
Succinate	+	+
Tartrate	+	−
Hydrolytic activity on:		
Casein	−	−
Cellulose	−	−
Chitin	−	−
Gelatin	−	+
Tributyrin	−	+
Starch	−	+
Production of specific enzymes or reactions:		
Catalase	+	+
Oxidase	+	+
Urease	−	+
Hemolysin	−	−
H_2S production	−	−
Indole	−	−
Methyl red	−	−
Voges-Proskauer	−	−
NO_3 reduction	−	−
Antibiotic susceptibility to:		
Ampicillin, 10 μg	+	+
Cephalothin, 30 μg	+	+
Erythromycin, 15 μg	+	+
Kanamycin, 30 μg	−	−
Neomycin, 30 μg	−	−
Penicillin G, 10 U	−	+
Streptomycin, 10 μg	−	+
Tetracycline, 30 μg	+	+

emend. (Flec.to.ba.cil lus. L. V. *flecto* to curve; L. n. *bacillus* a little staff, rod; M. L. masc. n. *Flectobacillus* curved rod.)

Straight to curved rods, the degree of curvature varying among individual cells within a culture; the most abundantly occurring cells are those in the shape of the letter "C." The cells measure 0.3 to 1.0 by 1.0 to 5.0 μm. Long, sinuous filaments up to 50 μm long are present. Rings 1.5 to 10.0 μm in outer diameter are formed by overlapping of the ends of a cell. Coils or helical spirals are infrequently formed. Gram negative. Nonmotile. Not flexible. Resting stages are not known. Colonies on *Microcyclus-Spirosoma* agar (with 3.0% NaCl for marine forms) contain a pale pink or rose-colored, non-water-soluble pigment.

Metabolism is respiratory; acids are produced aerobically from a variety of carbohydrates. Strictly aerobic. Chemoorganotrophic.

The guanine-plus-cytosine content of the deoxyribonucleic acid ranges from 38.3 to 40.3 mol% (buoyant density or thermal denaturation).

The type species is *F. major* (Gromov) Larkin et al. 1977.

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REPRINT REQUESTS

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